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nections are of universal occurrence. In the present paper[6] he describes and figures thin lines connecting the outer ends of *all* the cells of the cleavage and blastula stages of eggs from the following groups; Cœlenterates; Annelids; Mollusca; Tunicates; Mammals; Arthropods.

In life each cells has a faint outer periphery that is clearer than the rest; but it is only in sections that this layer, now seen as a stained line, passes over from one cell to the next so that the outermost contour of the entire egg is one continuous line of material.

In his method of preparation the cells split apart save for this peripheral line which thus becomes evident.

The author assumes that this connecting membrane is protoplasm, but it is unfortunate that he has no observations on living material to support this important claim and considering the remarkable effects often brought about by fixatives the question as to the true nature of this intercellular communication may well remain an open one. But the possibility that these connections may prove to be of similar nature to those described in the "spinning" of echinoderm eggs (AMERICAN NATURALIST, March, 1897) seems to the reviewer to add much to the probability that they are actual connections in the living egg.

From the author's point of view the blastula is one mass of protoplasm with a hole in the centre of it. He also points out the importance of the surface connection as a mechanical band; in fact he would ascribe to this many of the effects often attributed to surface tension of the individual cells. But regarding the connection as protoplasmic he emphasizes its importance as a *living* band and indicates its value as a basis for some of the assumptions of experimental embryologists as well as for the criticism of the cell theory by Whitman and by Sedgwick.

PSYCHOLOGY.[7]

Notes on Child Psychology—*Some Recent Literature.*—The past year has been one of remarkable activity in the sphere of Child Psychology everywhere, but especially in this country. *The Child-Study Monthly*, which was started in 1895, has published several articles of real value to the scientific investigator. The *Pedagogical Seminary* has been established upon a firmer footing. *Education*, *The Inland Educator*, *The Northwestern Journal of Education*, and other

[6] Archiv f. Mik. Anat. März 4, 1897, pps. 92–102, pl. 6.

[7] Edited by H. C. Warren, Princeton University, Princeton, N. J.

educational journals have devoted considerable space to child study. The works of Prof. Baldwin (*Mental Development in the Child and the Race*) and Miss Shinn (*Notes on the Development of a Child*) belong to the previous year; but two new studies of individual child development have appeared within the past twelve months. Mrs. K. C. Moore's monograph (*Mental Development of a Child*) is a very full record of the growth of her own child during its first two years; the author shows considerable judgment in her selection of material, as well as in its classification and discussion. Mrs. W. S. Hall has a similar study in hand, in a series of articles in the *Child-Study Monthly*, entitled *The First Five Hundred Days of a Child's Life;* five papers have already appeared; they are thorough and extremely suggestive. In connection with the statistical method, Dr. J. W. David, of Warsaw, reported at the Psychological Congress the results of a syllabus on the growth of ideas in children; he compared these results (on Polish children) with similar studies by other investigators in Germany and America. Mr. J. C. Shaw gives in the *Pedagogical Seminary* a statistical test of memory in school children. Prof. Sully's *Studies of Childhood*, while not statistical in method, contains a fund of material, new and old, on almost every topic of child study. Besides these general works, valuable contributions have been made by other writers to various branches of child psychology during the year.

Language.—It is interesting to compare the observations of Mrs. Moore (M) and Mrs. Hall (H) regarding the child's progress in learning to speak. The first sound observed by M was the short *a* uttered in crying; other sounds were made from the 36th day on, and ten days later responsive sounds were habitually made. No record was kept by H of the earliest babbling, except that the child began about the 47th day to "talk back" with the word "goo." H noted a distinction between the cries of hunger, pain, impatience and appeal by the ninth week, to which a cry of pleasure was added in the eleventh week. M noted different sounds for hunger and distress in the 12th week; these became real words by the 29th week. H observed the lip-movements corresponding to the words "mama," "papa" and "bye-bye" in the 32th week. The child's spoken words were first associated by him with definite objects in the 42nd week in both cases. The growth of vocabulary differed somewhat in form and rapidity. H records 3 words learned at the end of the 10th month, and 12, 24, 38, 58, 106, 199, at the end of the succeeding months; at the end of the 500 days the child was familiar with 232 words. M does not mention the progress by months, but records a vocabulary of 5 words at the end of the 12th month, 384 in the 22d, and 570 in the 24th.

Nouns and interjections were in each case the first parts of speech used: the verb appeared next, in the 11th (H) and 16th (M) months. Since the number of interjections (acquired first, H) remained practically stationary, while the nouns increased rapidly, and since the number of verbs began to increase rapidly only during the 16th month (from 8 to 28 in this month, H), the difference between the two cases is not so great as might appear. If we bracket together (1) nouns and interjections, (2) verbs, (3) adjectives and adverbs, and (4) prepositions, pronouns and conjunctions, the order of acquisition of the parts of speech was the same. The order of relative importance, according to H, at the end of the 17th month, was (1) nouns, (2) verbs, (3) adjectives, (4) adverbs, prepositions and interjections (equal), (5) pronouns, etc.; the same order is given by M at the end of the 24th month, excepting that pronouns had risen to fourth place.

The first sentence (in each case, "Papa, gone,") was formed in the 48th (H) and 66th (M) weeks respectively. The interrogative form appeared in the 69th week (H), and between the 66th and 79th weeks (M). As one record closes with the 72nd week, it is impossible to follow the progress further in this direction.

The comparison of these records suggests the desirability of a more uniform classification of data, as well as the need of extreme care in interpreting them.

Drawing.—One number of the *University of California Studies* is devoted to four studies, by careful observers, of the progress of individual children in learning to draw. Prof. E. E. Brown summarizes the results in a supplementary paper. In the first stage (scribbling), he finds the chief element to consist in the pleasure in producing (making marks, changes); the interest is in the *process* rather than the product. Later, comes the notion of *representing* something; there is now a mingling of visual with the earlier motor images; the latter predominate at first, but in the course of time the visual picture comes to control the motor presentation. These observations, says Prof. Brown, agree with those of Prof. Baldwin, except that in the California investigations the children were generally not provided with a copy, and the advance was consequently not so rapid. Prof. Brown is unable to set any time for the first appearance of tracery imitation, and believes that this idea must be present in some dim form from the start. He emphasizes the importance of imitation as a stimulus to drawing, as well as an aid to progress in the art.

In the *Pedagogical Seminary* for October, Prof. H. T. Lukens contributes an interesting series of drawings by several children, beginning with the earliest attempts, at two years three months of age. He suggests a classification of the progressive steps in learning to draw, parallel to those in learning to speak. In language: I. Automatic cries and reflex or impulsive sounds. II. Imitation of sounds, but without meaning (babbling). III. Understanding of words, but no speaking beyond "mama," "papa," "no," etc. IV. Repetition of words as mere sounds. V. Use of words to express thoughts. VI. Study of grammar and rhetoric. In drawing the corresponding stages are: I. Automatic scribbling. II. Scribbling localizations and imitation of movements of other person's hands. III. Understanding of pictures; only simplest localization of features, by scribbling. IV. Copying from others to see how to get the right effect in the use of lines. V. Picture writing, illustrated stories, etc. VI. Study of technique; perspective, proportion, shading, etc. The central point, however, in the development of drawing, according to Prof. Lukens, is the elimination of scribbling and simplification of the drawings into a few telling lines.

Prof. Sully discusses children's drawings at considerable length in his book, and reproduces a large number of attempts to draw a man. These drawings are mostly of a comparatively late period of development, and show the growth of the ideas of features, proportion, relation of full face to profile, etc.; the earlier scribbling is scarcely touched on. Prof. Sully gives three stages of progress in drawing: (1) vague, formless scribble; (2) primitive design; (3) a more sophisticated treatment of the human figure.

The observations of Mrs. Moore and Mrs. Hall close with the 17th and 24th months, a period too early to furnish any data on the subject of drawing.

Intellectual Work and Fatigue.—Two interesting papers on this subject were read at the Psychological Congress. Prof. Ebbinghaus reported a series of tests on school children, in which it was sought to determine the relative capacity of different ages and sexes for intellectual work, as well as the effects of fatigue. Dr. J. Friedrich's paper, since published in full in the *Zeitschrift f. Psychologie,* gave tests of a single school class at intervals of an hour during the entire school day. The methods used by the two observers were different. Prof. Ebbinghaus used three tests. 1. *Calculation.* The method of Burgerstein was employed; pairs of figures were given to add and multiply, and the number of such operations completed in ten minutes was taken as test. 2. *Memory.* A series of figures was dictated rhythmically, and after the list was read the subject wrote the numbers down as he remembered them. The series consisted of from 6 to 10 figures. The number of errors was taken as inverse measure of memory capacity. 3. *Combination.* Prose sentences were given (in writing), with words, syllables and groups of letters here and there omitted; the pupil was told to fill in the omissions. The number of syllables supplied within five minutes and the number of errors made in filling in were both taken into account. (The latter is open to criticism, since a false filling in of the text might, in certain cases, make as good sense as the original.) Prof. Ebbinghaus's tests were made on 15 classes of boys and 11 of girls of all grades; the same hours and days of the week were used in every case. The results showed in general an increase in exactness and capacity for work, corresponding to the increase in average age of the class; but this was subject to individual variations, a lower class being in some cases better than the next higher, although about a year younger on the average. The Combination method gave greater differences according to age than the Calculation method; the Memory method, in the application of which the individuality of the instructor played considerable part, showed irregular results. Dividing each class into three parts, according to scholarship, the methods gave quite different results. The memory tests showed no marked difference between good and bad scholars—if anything, it favored the latter; calculation showed a slight decrease from higher to lower; the combination tests, on the other hand, showed a marked difference in favor of the better scholars, as regards both the number of syllables supplied and the freedom from error. Comparing boys with girls, the latter were found to be inferior in the lower classes, but were somewhat superior in the highest classes; from which was argued a more rapid mental development among girls from the 12th to the 15th year. As to fatigue, the results agreed in general with those of Burgerstein and Laser. The capacity for work increased steadily to about the end of the third school hour, and then decreased somewhat, rising sometimes at the end of the school day. But the number of errors increased steadily throughout from the start.

Dr. Friedrich employed two methods in his tests. 1. *Dictation.* Twelve sentences were given, of about the same number of letters and signs, and about the same degree of difficulty. 2. *Calculation.* This consisted of five sums of two 20-place numbers, and five multiplications of 20-place by 1-place numbers. Each test was made at the beginning of the school day and at intervals of one hour. Some days a recess of 8 or 15 minutes was allowed between the hours, on others the lessons following without intervening rest. Comparing the two cases, it was found that the intellectual capacity of the scholar diminished as the length of the lesson increased. The recesses proven efficient in remedying this, especially the longer intervals of 15 minutes. The author concludes that the one-hour lesson period is too long for the best results, and that a recess of at least 10 minutes should be allowed between each period.

Fear.—Prof. Binet's study of Fear in the *Annee Psychologique* has already been noted in these pages. Stanley Hall treats the same subject exhaustively in a recent number of the *American Journal of Psychology.* Of 1,701 individual cases which he reports, nearly all are minors. 6,456 separate causes of fear are recorded: thunder and lightning was feared by the greatest number, 603; reptiles (483), strange persons (436), and darkness (432) follow next; then fire (365), death (299), domestic animals (268), disease (241), wild animals (206), water (205), insects (203), ghosts (203), rats and mice (199); a large number of other causes were confined to a few individuals. This classification is, perhaps, too minute for practical use. Combining the causes into larger classes, animals are found to be the cause of fear in 1,486 cases, celestial phenomena in 996, ghosts, etc., in 799, fire, water and drowning in 627, persons in 589, death or disease in 540. Pres. Hall points out the deep rooting of fears in human nature, and insists that the investigator must go far back in the organic series to reach any satisfactory ground for explanation.—H. C. W.

On the Effect of Music on Caged Animals.—Some time ago the writer was induced to experiment upon the animals in the Zoological Garden in Lincoln Park, with respect to the effect of music upon them, and the result may be of some interest to others working on psychological lines. The experiments were made at 6 o'clock P. M., two hours after feeding, and the instrument used was a violin.

Felis concolor Linné. Puma Panther. When the music first began two specimens of this species were resting in the back of the cage half asleep. At the first sound of the violin they started up, and could not for a time locate the sound, the writer being some distance from the cage. They showed, however, that they liked the sound, and when the player came as close as he could to the cage, they manifested their appreciation by lying down at full length and placing their heads between their paws. During this time the music had been of slow and sweet pieces, such as "Home, Sweet Home," "Annie Laurie," etc., etc. Suddenly, the player changed "Home, Sweet Home" to the "Irish washer-woman." At this change the panthers worked their tails nervously, and twitched their ears, and as it was kept up for a time, they got up and began pacing up and down the cage. From this action the writer judged that either the jig music, being sharp and piercing, hurt their ears, or that it was distasteful. After playing several jigs of this kind the player again relapsed into soft strains, when the animals slowly settled down in their old positions.

Felis onca Linné. Jaguar. This animal behaved much as did the panthers. While the jigs were being played he acted in a very nervous manner, jumping from a shelf to the floor of the cage and back again. Soft music seemed to quiet him. As the writer was leaving the jaguar's cage, having ceased playing for the time being, the animal walked up to the corner and reached out with his paw toward the player as far as he could. Whether this action was intended to call the player back, or was simply done to catch hold of him, as many animals will do if a person gets too near to the cage, the writer cannot say. It was a curious fact that when the paw was extended the claws were all *retracted.*

Felis leopardus Linné. Leopard. Two specimens of this species did not seem to notice the music to any extent, except at first, as a matter of curiosity.

Felis leo Linné. Lion. The lioness Juno, with her three cubs, occupied a large cage and the player's attention was next directed to these. While the music was being played to the other animals the lioness and cubs had been listening and watching, the cubs playing about their mother's haunches. As the violinist drew near the cage the cubs scampered behind their parent, the latter greeting the player with a gentle hiss As the music struck up a lively jig the cubs stood upon their hind legs and peeped at the player over her haunches. They appeared very curious and much puzzled, hearing these sounds for the first time. Desiring to test their appreciation, the player slowly backed away from the cage, playing all the time; as he retreated, the cubs gradually came to the front of the cage, and the mother crawled to the front and placed her two fore-paws between the bars and stuck her nose through as far as she could. After retiring to the side of the hall the player again moved toward the cage, but the family did not move, nor evidence any displeasure when he came very close to them, in fact, so close that he almost touched the great paws of the lioness. As he played the soft strains of "Home, Sweet Home" the cubs and mother sat motionless. in rapt attention, the former turning their heads from side to side. A jig played very rapidly caused the cubs to prance about in a lively manner.

Felis tigris Buff. Bengal Tiger. The music had a peculiar effect on the pair of animals in this cage. The male paid absolutely no attention to it, save glancing in the direction of the player and giving a vicious snarl. The female, however, acted as though she liked it, for she jumped upon a shelf and placed her paws and nose through the bars as described under the last species. A second experiment with the male, later, when he was stretched out upon the floor of the cage, caused him simply to look at the player, twitch his ears, and viciously spit and snarl at him. The female, however, on all occasions showed that music was not distasteful to her and that it was, on the whole, pleasing.

Hyena vulgaris Buff. Hyena. This animal is probably the most cowardly of all the mammals, and the only effect which music had upon two individuals was to cause them to retreat to the farther end of the cage and try to squeeze out between the bars. A lively jig frightened them nearly to death, and made them tremble in every limb. Strange to say, however, they did not howl or make the least noise.

Quadrumana. The Monkeys. (Genus *Cynocephalus.*) The monkeys evidenced great curiosity at the music, but did not seem to show either pleasure or displeasure at the sounds. A South American Sooty Mangabey, however, seemed to be rather pleased with the strains, particularly the jigs. This animal is of a quarrelsome disposition, and is therefore kept separate from the other monkeys. It was thought by Mr. Sweeney, the keeper, that the sounds might awaken a feeling of anger in him, but such was not the case. As the violinist drew away, he followed as far as his cage would allow. A spark of reason was observed in this animal. His cage is of glass all around, and in order to hear the music better he placed his ear to a crack in the door. This he did several times as the player drew near or went farther from the cage. The monkeys confined in the larger cage, also of glass, formed themselves in a broken semi-circle about that part of the cage nearest the violinist, and looked at him in apparent wonder. As he moved away from them, they arose from their sitting posture with one accord and followed him along the side of the cage. This was probably simply curiosity, although the music may have given them some pleasurable sensations. On the whole, the monkeys did not show as much intelligence as might have been expected from their high position in the scale of nature.

Pilecanus fuscus Linné and *P. erythrorhynchus* Gm. Brown and White Pelicans. The pen containing these birds is situated next to the monkey cage, and the music was next tried upon them. The effect was somewhat startling, for they all began to jump about, flap their wings, and snap their huge beaks; this might, perhaps, be called dancing.

When the violinist drew near the cage they snapped at him with their beaks.

The other birds in the animal house paid very little attention to the music, partly, perhaps, because they were sleepy. Several varieties of parrots, herons and smaller birds were tried in turn, but without producing any results worthy of mention.

Canis latrans Say. Coyote. The last experiment tried was upon a den of coyotes in the park. When the playing began all the animals were in their holes, but the first note had hardly been struck when they came running out, and raced up and down their den until they had located the sounds. When this was done they all squatted in a semi-circle about the violinist, he having approached the bars of the den as near as possible, and sat in silence listening to the music. When it ceased they ran up to the player and pawed at him through the bars, indicating as plainly as possible that they wished to hear more. When he began to play again they again silently formed in a semi-circle. This experiment was tried a number of times, but always with the same result. During this time not a sound was uttered by the coyotes, but a wolf in the den adjoining howled lustily. Here, as in the other cases, soft, sweet music seemed to be better appreciated than loud, harsh music.

Besides music made up of regular pieces, all sorts of sounds were made by the violinist—screeches, piercing notes, imitations of a cat, cow-rooster crowing and pig squealing, but these did not seem to have much effect. The loud, harsh and piercing notes seemed to affect their ears, for they moved them about nervously as though the noise hurt the sensitive nerves. To sum up general impressions, slow and soft music was received, as a rule, with more signs of pleasure than the lively jigs. The females, also, seemed to pay more attention to the music, and to be more pleased with it, than were the males. The nocturnal mammals were more interested than were the diurnal birds. This was probably due to the fact that the experiment was tried after dark, when the animal house was lighted only by electricity. It was a curious and interesting fact that the whole performance was conducted without any noise other than an occasional grunt from the lions. The experiment is worthy of repetition, and should be made at different times during the day, as in the early morning and at noon, just before and after feeding, etc., to see whether or not these conditions have any effect upon the result. The writer is convinced that many interesting and valuable facts may be learned by experiments of this character.

—Frank Collins Baker.